Earth Sciences Program
Academic Program Evaluation
February 5, 2018

Criterion 1 Impact and overall essentiality of the program

Preparing students in the STEM fields is critical to the continued advancement of the communities within the San Luis Valley (SLV), the state of Colorado, and the United States as a whole. Given our location, we are well suited to prepare students in fields that impact the environment and our natural resources. The Earth Sciences program has an excellent retention rate, evidenced by our average number of majors (~45) and our graduation rate (>8 per year). A major reason for this is our geographic location in the SLV which represents an outdoor laboratory for the study of geology, geography, and environmental science. The SLV also contains numerous public lands and conservation agencies where our graduates are employed as GIS professionals, wildlife officers, and geologists. Adams State University is perfectly poised in the SLV to become a destination school for students interested in the earth and environmental sciences. Our Earth Science graduates also currently teach in local school districts, hold positions inside and outside the SLV with state and federal natural resource agencies, are scientists in geology, environmental science, and industry, and are contributing to their field through study at the graduate level.

The Earth Science Program aligns with each of the five ASU 2020 goals as described below.

Goal 1: Academic Excellence: Adams State University will provide challenging and responsive curricula that educate, serve, and inspire our diverse populations.

The Earth Sciences program provides challenging courses and curricula (Strategic Initiative 1.1). Our students take 37-50 credits within their major and our B.S. programs in Geology, and Physical Geography and Conservation require a broad set of science and math courses outside the earth sciences including physics, chemistry, biology, trigonometry or calculus, and statistics. This keeps our students competitive for careers after graduation. We are constantly modifying our curricula and courses to stay responsive to changes in national trends, such as our recent degree track change to “Physical Geography and Conservation” to reflect upward trends in conservation careers (Strategic Initiative 1.1 and 1.3). Students are engaged and inspired in Earth Science courses, evidenced by our high retention rate.

The Earth Science program fosters a civic responsibility in our students through a responsive education in global issues such as environmental stewardship, cultural awareness in geography courses, and climate change (Strategic Initiative 1.2).

Earth Science faculty are dedicated to inclusivity and have engaged in numerous diversity and equity workshops in order to gain skills that foster engagement and understanding of our diverse students (Strategic Initiative 1.4).

Goal 2: Student Success: Adams State University will address diverse student needs by offering varied learning opportunities and support services for all students to achieve educational, personal, and career successes.

Earth Science professors engage students in varied learning opportunities including field trips, undergraduate research opportunities, and travel to regional and national conferences (Strategic Initiative 2.4). Mentored research has led to student presentations at ASU Student Scholar Days, regional meetings (e.g., Association of American Geographers), and conferences

of national/international professional societies (*e.g.,* Geological Society of America, *American Association of Geographers*). Earth Science faculty have taken over 60 students to national professional conferences since 2013 and over 30 of those students have presented as authors or coauthors. All of these presentations represent national-level published abstracts for our students. This is a significant achievement for undergraduate students (Strategic Initiative 2.5) and a boost to their future career and/or graduate school prospects.

National Conference	# Students Attending	# Students Presenting
Seattle 2017: Geological Society of America	5	2
Boston 2017: American Association of Geographers	8	6
Denver 2016: Geological Society of America	12	2
San Francisco 2016: American Association of Geographers	4	2
Chicago 2015: American Association of Geographers	7	4
Vancouver 2014: Geological Society of America	4	5
Denver 2013: Geological Society of America	12	5
Los Angeles 2013: American Association of Geographers	9	6
Total Student Numbers	61	33

Faculty in the Earth Sciences are committed to providing research opportunities to our students. Evidence suggests that students who become involved with undergraduate research are more likely to persist in STEM majors. Our commitment to undergraduate research is evidenced by the 33 students who have presented research at national conferences in the past five years. Some of the recent projects include:

- *Soils and Landscape Evolution of the Fossil Creek drainage basin, Fort Collins, Colorado*
- *Postglacial Paleoclimatic Fluctuations Driving Terrace Development in the Southeastern San Juan Mountains of Colorado*
- *Geomorphology at the Fort Massachusetts Archaeological Site, Colorado*
- *Soils and Geoarchaeology of the Upper Rio Grande Basin, San Juan Mountains, Colorado*
- *Building Geomorphic GIS Databases*
- *Methods of Reconstructing Paleoenvironments in Mountain Valleys: Dendrochronology, OSL, 14C, 10Be, and Soils on Moraines and Terraces, Colorado*
- *Geomorphology of Mammoth Sites in the San Luis Valley, Colorado*
- *Remote-Sensing Analysis of the Rio Grande near Alamosa, Colorado, using Unmanned Aerial Systems*

In addition to undergraduate research opportunities, faculty in the Earth Sciences are committed to providing experiential learning opportunities, classroom-based research projects, and field

experiences. Just this past fall, one professor took students to a mammoth site here in the SLV, where a freshman earth science major actually discovered a buried, intact mammoth tooth (Strategic Initiative 2.5). Experiential learning opportunities are offered in the following courses:

- Nature and Properties of Soils: Map and describe soils on fluvial landforms in the San Juan Mountains
- Geomorphology with Environmental Applications: Measure lichen on rock glaciers and map the distribution and ages of glacial deposits in order to apply this to climate change
- Natural Resource Management: Work with local management agencies to study conservation issues in the SLV
- Geoarchaeology: Determine the relationship between soils and archaeology at the Fossil Creek Site in Fort Collins, CO
- Remote Sensing: Design aerial photography flight paths for river flow image collection and image analysis using GIS and imaging software
- Field Geology: capstone level data geologic mapping in multiple settings in the field

Earth Science professors have an open-door policy and students know that they can talk with them about educational, personal, and career concerns and questions. In addition, the faculty are committed to high-impact practices in our teaching as evidenced by our participation in workshops and conferences focused on pedagogy, such as:

- Equity in Education, Online Leadership Institute, 3 credit online course
- Certificate in College Teaching and Learning through ESCALA Educational Services (2 faculty)
- Writing Across the Curriculum, Title V ISES, Alamosa, CO
- HILOS Institute, five-day retreat, cultural and educational workshop, San Luis, CO
- Teaching Climate Change Workshop, Laramie, WY
- Teaching About Energy in Geoscience Courses: Current Research and Pedagogy Workshop, Denver, CO
- How to Establish and Sustain an Undergraduate Research Program workshop, Las Vegas, NV

Faculty in the earth sciences direct student groups on campus:

- Geo Club: A student club for majors and minors in geology, geography and conservation, and environmental science. Among other ventures, the Geoclub has helped fund our significant student travel to national conferences.
- E.A.R.T.H.: A student-centered, campus environmental action group.

Earth Science faculty have worked with the degree plans to make the completion of the degree possible in 3 years for an ASU student who declares their major in their sophomore year. Further, we have worked with the Community College (CC) system to develop degree tracks that are possible in 2 years as long as CC students took the correct course sequence in their first two years (Strategic Initiative 2.1 and 2.2).

All Earth Science faculty have attended numerous advising workshops held at ASU (Strategic Initiative 2.3).

Goal 3: Personal and Professional Development: Adams State University will provide educational and professional development opportunities for faculty and staff.

The Earth Science program faculty are active in educational and professional development. We have received support from the department, the VPAA Faculty Development Fund, the Title V

HSI-STEM grant, and other Title V grants for a number of educational and professional development opportunities (both on and off campus), such as:

- Attendance at national and international conferences (Strategic Initiative 3.3)
- Western Slope Field Conference (Strategic Initiative 3.3)
- Workshops related to pedagogy (Strategic Initiative 3.2)
- Workshops and retreats related to diversity and equity (Strategic Initiative 3.1)
- Appreciative advising workshops (Strategic Initiative 2.3)
- Hilos Culturales summer institute (Strategic Initiative 3.1 and 3.2)

Goal 4: Access & Affordability: Adams State University will develop innovative pricing and aid strategies that will maximize opportunities for our diverse and historically underserved students for all levels and delivery models.

While our program does not participate in setting institutional fee structures for students, we have kept our course fees at a minimum. The course fee is $13.80 per laboratory/field-based course (laboratory fees at other Colorado universities are $20 or more). These fees help to offset the cost of laboratory materials, equipment repair and calibration, and field travel, as our budget has not kept pace with inflation. Despite this, we are providing students with high quality programming.

In addition, we offer tutoring and supplemental instruction, free of charge to ASU students enrolled in STEM courses, through the STEM Center (Strategic Initiative 4.1). Through the Porter Scholars program, we are able to provide scholarships and funding for Focused Academic Programs (*i.e.,* research, academically related travel, field camp).

Goal 5: Community Relations: Adams State University will collaborate with the community to provide culturally responsive and sustainable development opportunities that mutually benefit the campus and the San Luis Valley community.

The SLV is an outdoor learning laboratory for the Earth Science program. We utilize the natural environment of the SLV for experiential learning in the following ways:

- Community members join us in some of our courses.
- We lead Earth Science field trips in the SLV and surrounding mountains (Stategic Initiative 5.5)
- Earth Science faculty are involved with research projects in collaboration with local management agencies here in the SLV that provide educational information to the community (Strategic Initiative 5.3)
- One professor published a paper on local mammoth sites in the regional journal “The San Luis Valley Historian.” (Strategic Initiative 5.4 and 5.5)

An Earth Science faculty member has collaborated with a member of the History program to compile a book called “The San Luis Valley: Geology, Ecology, and Human History.” This edited volume will help to build understanding of the natural and cultural history of the SLV among our campus and community (Strategic Initiative 5.4).

The Earth Science program cultivates relationships with alumni (Strategic Initiative 5.6). For example, one professor invites alumni who work in natural resource management agencies here in the SLV to give talks to current students. This cultivates relationships with alumni, the agencies, and benefits our current students.

Criterion 2 Quality of program outcomes

Results of annual assessment reports

Assessment feedback was provided in different formats throughout the last five years, with numerical scores provided only for the past 3 years. The feedback is summarized in Table 2.1.

Table 2.1. Summary of assessment feedback. Numerical scores were based on the scale of Excellent = 2, Adequate = 1, and Incomplete = 0

Short-form Question	AY 12-13	AY 13-14	AY 14-15	AY 15-16	AY 16-17
Information/Evidence/Data Gathered to Inform Department of Student Learning	Excellent	Excellent	1.00	1.50	1.286
Departmental Discussion of Information	Excellent	Excellent	1.67	1.875	1.429
Discoveries/conclusions	Adequate	Adequate	0.83	2.00	1.857
Planned Actions Based on Discoveries About Students and Their Learning	Excellent	Excellent	1.17	2.00	1.857
Support/resources	Excellent	Excellent	1.33	1.75	1.143

The earth science faculty have continued to develop a better understanding of the assessment process over the last five years and are committed to using the information to improve our curriculum. While our "scores" have varied a bit over the years, we do face some challenges in assessment due to the lack of a nationally standardized exam (*e.g.,* MFT) and having only two faculty in the program who score the assessments.

A few noteworthy comments from the most recent evaluations:

- *Also of note is the department's progress using assessment. Conclusions in this year's report compared to prior years were more strongly based on student artifact evidence.*
- *Strengths - The department has worked hard in the last year to revise program goals and SLOs. These activities should improve assessment efforts in the future.*
- *Strengths: Holding retreats specifically focused on assessment.*
- *Challenges: All assessment instruments are local; no outside comparisons were made (MFT, for example).*
- *Scoring of assessments in such a small department would create some difficulties. The fact that no data was gathered while a faculty member was out on sabbatical is unfortunate also. It seems that a good meeting plan was put in place for fall semester in order to tighten up the rubric and make plans for next year.*
- *it appears the program has jumped in and are using different assessments and plan to continue to adjust where needed.*

Scores of graduates on national assessments

There is no ETS Major Field Test available for the Earth Sciences. We have used the ACAT exam as a measure of achievement for the Geology majors; the five-year test score data is presented in Table 2.2. No discipline-specific national exam is available for the physical geography majors.

Table 2.2. Comparing Graduating ASU Geology Majors and National Means on the ACAT Test. No ASU data available for 2017.

Year	ASU mean	ASU *N*	National Institutional Mean	National Institutional *N*
2013	440	5	475	16
2014	569	3	490	16
2015	495	4	496	16
2016	-	0	481	16
2017			517	16
Average	501		497	16

ASU geology students score well using the ACAT data on a year-by-year basis, with an average over the 2013-2015 reporting period of 501 compared to a national average of 497. There does appear to be a cycle to the overall annual test scores. The score ups-and-downs may very well correlate with the biannual offerings of many of the classes that are tested in the sub-disciplines.

While very respectable scores are realized on the ACAT exam by ASU geology majors, the exam is not a perfect assessment instrument for ASU for 2 significant reasons. One, some subject areas on the test are not areas that are specifically taught in the Geology major, such as oceanography, and secondly, the 16 institutions that are part of the testing group are not good peer institutions as many of them are research universities. However, given these caveats, ASU graduating seniors are scoring close to or above the national ACAT average. The ACAT scores strongly suggest that ASU Geology program graduates are able to demonstrate a broad understanding of the concepts, theories, and facts within the earth sciences.

Jobs secured by graduates

The faculty within the earth science program are committed to preparing graduates that are nationally competitive for jobs in natural resource agencies, industry, outdoor education, and secondary education. Our placement rate (student-reported) has been 100% in all areas when looking at both the 5-year and 12-year averages (Table 2.3). We do recognize that students will not report failed job attempts, which skews this data.

Table 2.3. Earth Science Program Job Acceptance Rates Hiring rate is given as percent of students who applied and were hired; based on student reported information. 5-year average is based on graduates in AY2012-13 through AY2016-17. *Note that outdoor education hires were not tracked until AY 2012-13.

	5-year		12-year rate	
Position Type	**% of graduates applying**	**Hiring rate**	**% of graduates applying**	**Hiring rate**
Natural Resource Agencies	54.5	100	29.7	100
Industry*	18.2	100	17.6	100
Outdoor Education	13.6	100	4.1	100
Secondary Educators	9.1	100	4.1	100

In the last five years, we have placed at least 8 students in internships with different resource management agencies and non-government agencies, and at least 19 of our graduates have found permanent jobs in natural resource management, industry, and outdoor education.

Admission and admission rates to graduate or professional schools

The faculty within the earth science program aim to prepare graduates that are nationally competitive for acceptance into graduate programs. As evidence of our success, our students have very high rates of acceptance with 5-year and 12-year averages presented in Table 2.4.

Table 2.4. Earth Science Program Acceptance Rates. Percent acceptance is given as percent of students who applied and were accepted; based on student reported information. 5-year average is based on graduates in AY 2012-13 through AY 2016-17.

	5-year rate		12-year rate	
Position Type	**% of graduates applying**	**% Acceptance**	**% of graduates applying**	**% Acceptance**
Graduate school	22.7	100	12.2	100

Both the five-year and 12-year average for acceptance to graduate schools is 100% (student reported data). In the last five years, 5 students have matriculated into a graduate program.

Criterion 3 Demand for the program

Internal demand: Induced Course Load Matrix – multiple slices.

In reviewing the Induced Course Load Matrix, it is apparent that the earth science program is not only educating our majors, but is also providing general education opportunities for a broad range of majors. In addition, we have made some changes in course prerequisites so that wildlife biology majors could complete some relevant earth science courses such as Biogeography, GIS, Sedimentology/Stratigraphy, and Nature and Properties of Soils. Table 3.1 summarizes the percent of earth science credit hours completed by the majors as well as all other majors combined, which is an indication of our service to general education on campus.

Table 3.1. Percent of Earth Science credits completed by student major. Note that the induced course load matrix combined geology, geography, and environmental science into one category, GEOL, which we refer to as Earth Sciences. There is no environmental science major, so we assume that these numbers include enrollment in ENV 101 Introduction to Environmental Science.

Year	majors	All others
2014-15	45.9	54.1
2015-16	45.6	54.4
2016-17	45.8	54.2
Average	45.77	54.23

It should be noted that while the total university headcount has decreased from 3444 in 2012-13 to 2750 in 2016-17, a decrease of ~20%, the head count in earth science has decreased by only 13.7% (51 in 2014-15 to 44 in 2016-17). In addition, over the five-year period, 96 students completed one of the minors offered by the program (Table 3.2).

Table 3.2 Number of minors completed by year. Note that the physical geography minor was not available until fall 2012.

	2012-13	2013-14	2014-15	2015-16	2016-17	Total
Geology	3	2	2	1	1	9
Physical Geography*	-	2	9	5	5	21
Environmental Science	18	11	13	10	14	66
Total	21	15	24	16	20	96

Clearly the environmental science minor is very popular and may be a good predictor for the success of a potential major in this area.

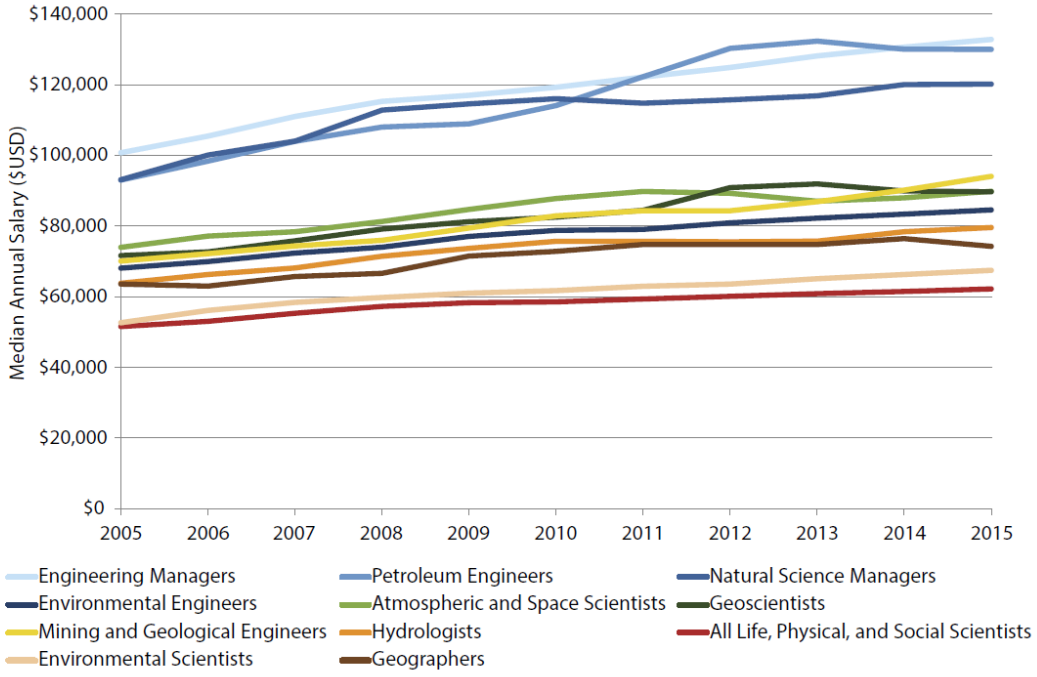
Employment opportunities: national and state statistics

According to the Bureau of Labor Statistics, projected job growth in fields that our graduates have historically entered will continue to increase faster than average (10 to 14%) through 2026 (Table 3.3). The field of Cartography and GIS is predicted to increase much faster than average (>15%) and represents an area of potential growth for the earth science program (Criterion 7).

Table 3.3. Job outlook for Earth Science disciplines (Bureau of Labor Statistics)

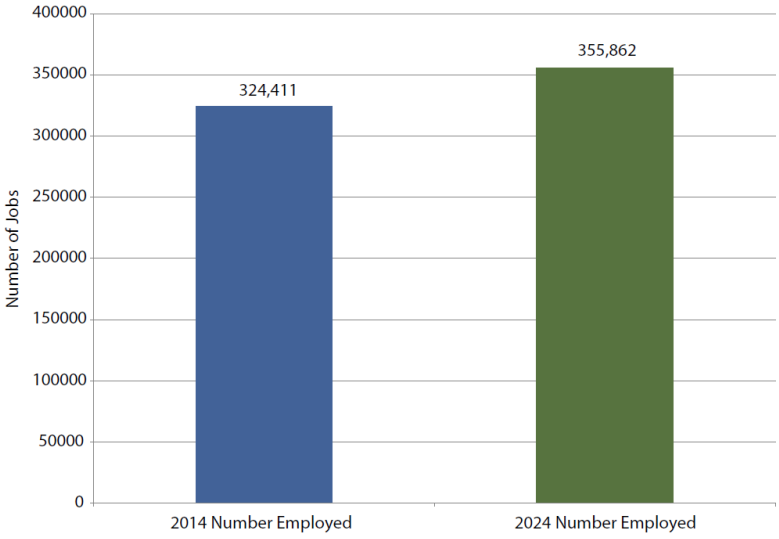
	Growth (2016-2026)	Median wages (2016)
Environmental Scientists	Faster than average (10 to 14%)	$68,910
Geoscientists	Faster than average (10 to 14%)	$89,780
Cartography and GIS Technicians	Much faster than average (>15%)	$62,750
Natural Science Managers	Faster than average (10 to 14%)	$119,850
Hydrologists	Faster than average (10 to 14%)	$80,480
Climate Change Analysts	Faster than average (10 to 14%)	$68,910

The above job outlook data suggest that career opportunities in the Earth Sciences are growing fast. Additional data from the American Geological Institute (Wilson, 2016) supports this upward trend for careers and salaries in the earth sciences (Figure 3.1, 3.2, and 3.3). Median salaries are continuing to increase for geosciences graduates, with geoscientists in the private sector realizing median annual salaries of $89,700.



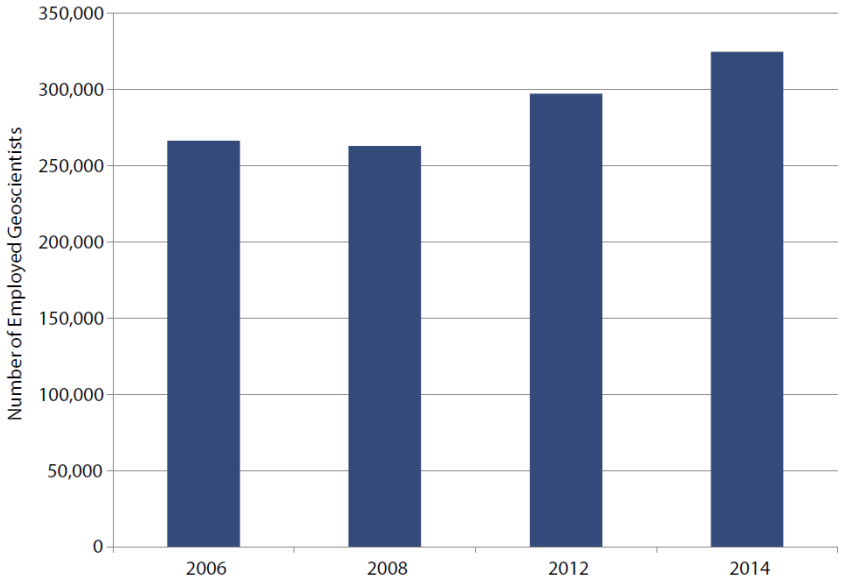
AGI Geoscience Workforce Program; Data derived from the U.S. Bureau of Labor Statistics, National Occupational Employment and Wage Estimates

Figure 3.1 Median annual salaries of Geoscience (Earth Science) occupations (2005-2015)
Median annual salary of all U.S occupations in 2015 was $36,200.



AGI Geoscience Workforce Program; Data derived from the U.S. Bureau of Labor Statistics, Employment Projections

Figure 3.2 Employment Projection for Geoscience (Earth Science) occupations (2014-2024).



AGI Geoscience Workforce Program; Data derived from the U.S. Bureau of Labor Statistics, Employment Projections

Figure 3.3 Total number of Employed Geoscientists (Earth Scientists) in the United States.

- A shortage of 90,000 geoscientists is projected as much of the current workforce retires.
- There were 324,000 geoscientists employed in the United States, in 2014. Forty-eight percent of the workforce will be at or near retirement over the next decade (Wilson, 2016).

10-year trend of graduates (3-year rolling averages)

The number of earth science graduates has fluctuated over the last ten years, with increases in 2012-13 and 2014-15 (Figure 3.4). The 3-year rolling average is presented in Figure 3.5. The trend is clearly upward.

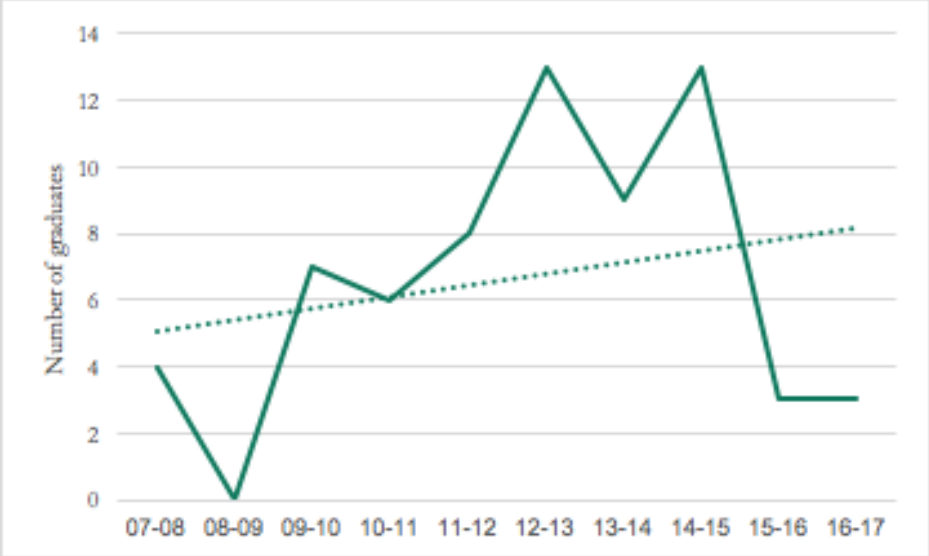


Figure 3.4. Total number of Earth Science graduates over a 10-year timeframe (2007-08 through 2016-17)

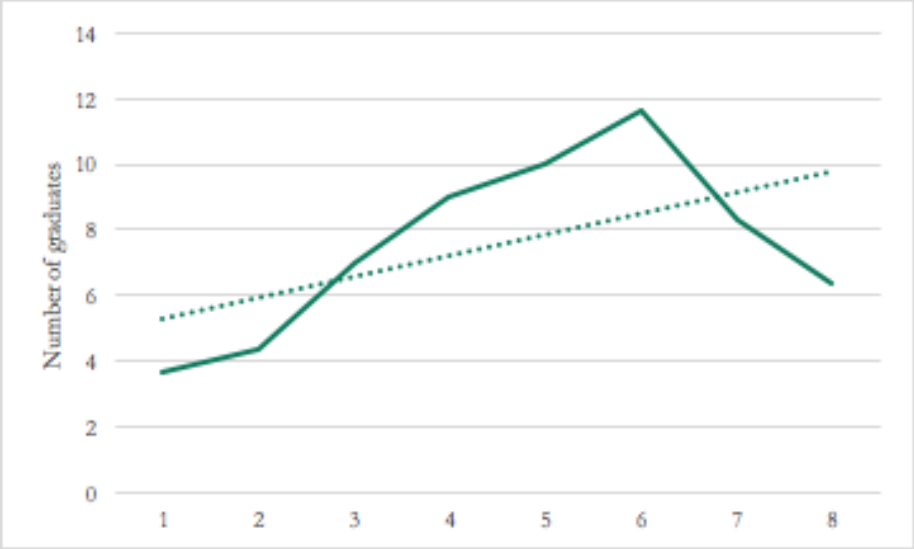


Figure 3.5. Three-year rolling average of Earth Science graduates over a 10-year timeframe (2007-08 through 2016-17)

The rolling average indicates an overall upward trend, which mirrors the trend in graduates within the state of Colorado (Figure 3.6). We believe it's important to note that numbers of Earth Science graduates are up this year (2017-2018) with 5 graduates in fall 2017 and another 5 anticipated in spring 2018 (10 graduates in 2017-2018).

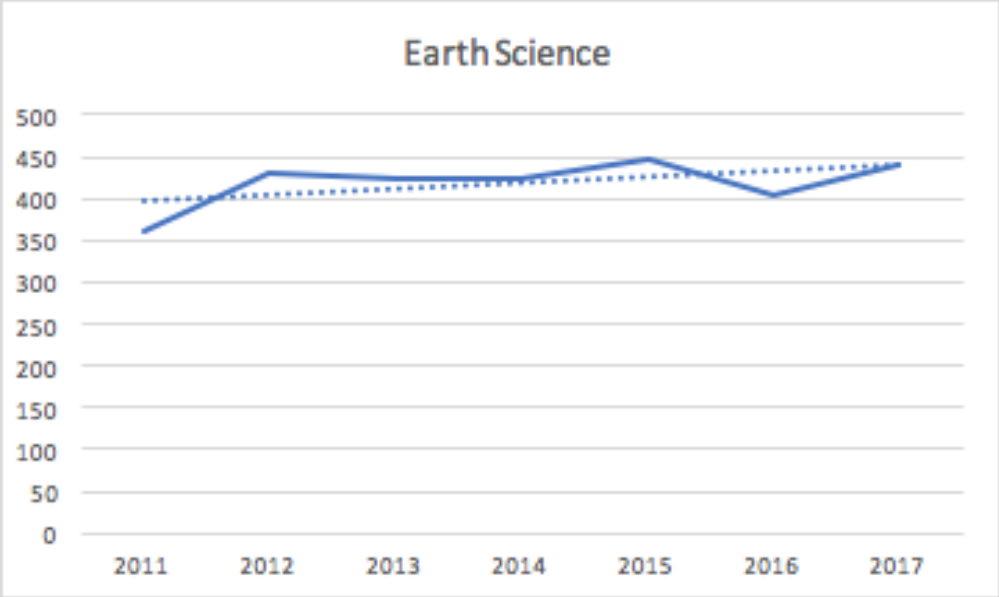


Figure 3.6. Trend in earth science graduates in the state of Colorado

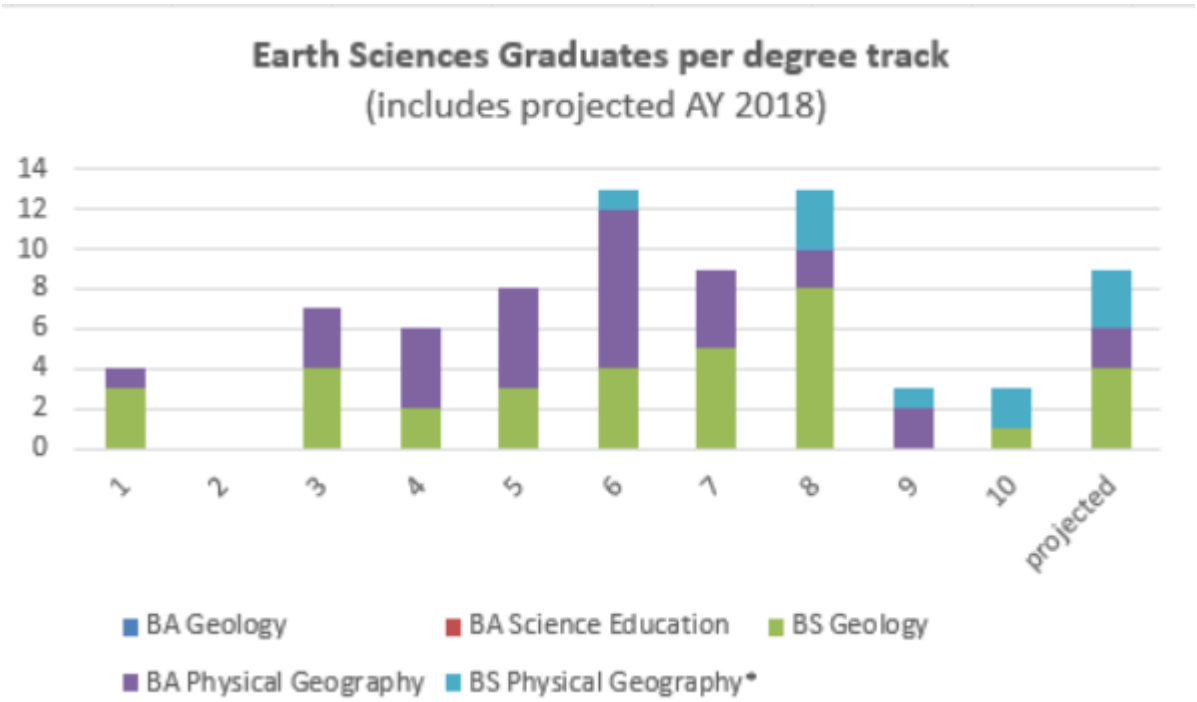


Figure 3.7 Degrees awarded by degree track over a 10-year timeframe (2007-08 through 2016-17). *The B.S. Physical Geography major was introduced in Fall 2012 (Year 6).

The Earth Sciences degree tracks all show positive growth trends, with the exception of the BA Geology and the BA Science Education. The reason for low utilization of these BA degree tracks appears to be less science course-work and flexibility. Earth Science graduates who are presently teaching had no trouble securing teaching positions with a BS, and will be able to enter the workforce or graduate school in the geosciences if teaching fails to meet their professional expectations. A master's degree was the historic entry-level employment qualification in industry, but more and more employers are hiring BS graduates (Wilson, 2016).

A brief downturn in program graduates occurred from 2015-2016, with much improved graduation numbers expected this year (~10). The BA and BS Geography degrees together tend to be more popular, with the the BS Geology degree close behind.

We do not have data for the sizes of incoming cohorts of earth science students each year. For this reason, it is difficult to calculate a retention rate. We do know, however, that our retention rate is high based on our graduation rate. A method for calculating graduation rate is the average number of graduates each year, divided by the average number of students in each class (Table 3.4).

Table 3.4 Graduation rate for Earth Sciences (5 yrs of data)

Average number of majors	Average number in each class (freshman, sophomore, etc.)	Average number of graduates	Graduation rate (graduates/number in class)
45	11.25	8.1	72%

National, state, and local enrollment trends

Recent data from the American Geosciences Institute (Wilson, 2016) indicate that:

- Earth science degrees are in demand. Nationally, there is an upward trend in earth science enrollment and graduation. This contrasts with overall numbers in all disciplines at colleges and universities, which is flat.
- The enrollment trend for Hispanic and African-American students in Earth Sciences mirror or slightly exceed this trend.

Only 18 Earth Science departments are located in Colorado institutions of higher-education, and ASU has the only program in Colorado with an HSI mission.

Local enrollment trends include:

- Thirteen students, both recent graduates and current Earth Science majors, transferred to ASU from two-year or four-year institutions. Front Range Community College and Pikes Peak Community College are the source of most of these transfer students, but some also transferred from four-year universities, such as the Colorado School of Mines and the University of Colorado.
- Over 100 students have attended the earth science program's summer field geology course (GEOL 495), representing more than 23 universities from across North America. Field course availability is considered a limiting factor to a graduate's employability.

Criterion 4 Size, scope, and productivity of the program

Degrees awarded – 5 years of data

Table 4.1. Earth Science degrees awarded and number of degrees per faculty. There are two full-time faculty in earth sciences.

year	# of degrees awarded	degrees/full-time faculty
2012-13	13	6.5
2013-14	9	4.5
2014-15	13	6.5
2015-16	3	1.5
2016-17	3	1.5
Total	41	20.5

For a department of two faculty, the total degrees awarded per faculty over the five-year period is substantial. On average, there have been 8 graduates per year or 4 graduates per faculty member. In AY 2017-18, we anticipate a total of 10 graduates. Over the last ten years, there have been 66 earth science students graduating with either a BA (29) or BS (37) degree.

Student credit hours (SCH) – 5 years of data

In addition to teaching all courses for the earth science majors, faculty also teach ENV 101 (general education course) twice during the academic year. As ENV 101 is typically offered Fall, Spring, and Summer two-thirds of the SCH for this area is included in the calculations for the Earth Science Program (Table 4.2).

Table 4.2 Total SCH and SCH per faculty. There are two full-time faculty in earth sciences. Average SCH per unit was calculated as Total University SCH / number of Organizational Units.

year	SCH (GEOG and GEOL)	SCH (ENV)	Total SCH (Earth Sciences)	SCH/FT Faculty	Average SCH per unit
2012-13	1503	405.4	1908.4	954.2	1810.8
2013-14	1078	474.6	1552.6	776.3	2001.3
2014-15	1011	397.4	1408.4	704.2	1901.4
2015-16	1184	421.4	1605.4	802.7	1743.7
2016-17	1120	328	1448	724	1610.9
Average	1179.2	405.4	1584.6	792.28	1813.6

The earth science faculty have an average SCH production over the five year period that is near the average for all units of the university. The SCH per faculty member is quite high, but this is likely skewed by the inclusion of GEOG 300 World Geography in the SCH data provided. This course is taught by a faculty member in HAPPS.

Service to campus

All tenured and tenure-track faculty within the department are expected to participate in campus service, with the exception of first-year faculty who need the time for course development. Table 4.3 shows the number of committees, task forces, or other campus-wide service activities by faculty member.

Table 4.3. Campus-wide service by faculty member for a five-year period (2012-13 to 2016-17) This table includes the number of committees in each category on which an individual faculty member served. Years of service are noted parenthetically.

	1	2
Standing Committees (CRC, GECC, HPAC, Student Scholar Days)	Curriculum Review Committee (1)	Student Scholar Days (2)

Search Committees (Outside Department)	Director of Bands	ASU President School of Business Chair
Retention Committees (Outside Department)		School of Business (4 committees, 2 yrs each)
Task Forces (ASU 2020, STAMP, CIT, HIP Team)		CIT (2) HIP (1)
Tenure, Promotion, Peer Recognition Committees	Tenure and Promotion (2)	Tenure & Promotion (3)

Earth Science faculty are members of campus committees that are necessary for the function of a university. By serving on search, retention, and tenure/promotion committees across campus, earth science faculty participate in the important job of new faculty recruitment and retention. faculty have also been active in shaping new programs and advancing new initiatives.

Fraction of tenured & tenure-track faculty engaged in campus-wide committee leadership (chairs)

In addition to serving on campus-wide committees, members of the earth science program faculty have assumed leadership roles on committees and in institutional governance (Table 4.4).

Table 4.4. Campus-wide committee leadership by faculty member for a five-year period (2012-13 to 2016-17) This table includes the number of committees in each category on which an individual faculty member served in a leadership position.

	1	2
Institutional Governance	Faculty senator (2)	Faculty Trustee (3 terms)
Standing Committees (CRC, GECC, HPAC, Student Scholar Days)	Curriculum Review Committee (1)	
Search Committees (Outside Department)		
Retention Committees (Outside Department)		
Task Forces (ASU 2020, STAMP, CIT, HIP Team)		HIP (1)
Tenure, Promotion, Peer Recognition Committees		

The data in Table 4.4 represent two full professors, both of whom have held leadership positions throughout their tenure at ASU, not only during the last five years. It should be noted that one faculty member has held the position of Faculty Trustee for three terms.

Service to community & community engagement

A University is often the heart of its community, offering community members academic and creative programming. The earth science faculty have been engaged in a wide variety of community service activities (Table 4.5).

Table 4.5. Service to the community and community engagement by faculty member for a five-year period (2012-13 to 2016-17) This table includes the community service activities in each category in which an individual faculty member participated; number of years is given parenthetically. Leadership positions are also noted.

	1	2
P-12 Outreach (STEM Saturdays, material loans, classroom visits)	Visit to Center HS and Middle School	Ryan Museum tours, mainly P-12 community (5) Summer STEM Academy (4) Migrant STEM Academy (2)
SLV Regional Science Fair, local school fairs	San Luis Valley Science Fair (5)	SLV Regional Science Fair Team Leader (5) State Science Fair Scholarship awards (2)
Community Leadership (School Boards, agency boards)	Colorado Field Institute (2)	
Outreach to general public	Geomorphologist on Cumbres and Toltec Geology Train (1)	Lead geologist, Cumbres and Toltec Geology Train Excursion (5) Providing geologic information to community members as requested, i.e., mineral identification and general Earth history. Hosted Colorado Museum Association visit to Ryan Museum

Earth Science faculty are engaged with the P-12 community through involvement in the SLV Regional Science Fair, Summer STEM Academies, and visits to the Edward Ryan Geological Museum. The Earth Science faculty also offer educational opportunities for adults in the community including Earth week activities and Cumbres & Toltec Geology Train Excursions. Due to a favorable response during the Colorado Museum Association visit to the Ryan Museum, ASU may be selected for the 2020 convention.

Despite high contact hours (average of 17.4) for full-time faculty, all Earth Science faculty are engaged in campus and community service.

Brief write-in summary of discussion & evidence pertaining to this criterion, but not captured by the above measures

E.A.R.T.H. Group Impact

The campus- and community-wide E.A.R.T.H. Group (Environmental Action for Resources, Transportation, and Health) has been led over the past 5 years by an earth science professor.

E.A.R.T.H. is actively working to make our campus more sustainable. This group is important on two levels. First, they spread awareness of environmental issues to students, faculty, and staff by:

- hosting speakers, videos and save the planet festivals,
- involving students in environmental issues,
- organizing events on campus such as "Catch recyclers green handed" and our annual EARTH Week.

Second, they enlist student volunteers and work study students to implement important green changes on campus. This includes:

- campus-wide recycling program,
- smaller pilot recycling programs,
- environmental outreach,
- Campus Community Garden development

The successful recycling program was launched as a pilot project with color-coded recycling bins in Porter Hall and Nielsen Library and has now grown to encompass all academic buildings and is moving into the student dorms as of spring 2018. Other campus initiatives have included:

- “Green Bikes” program
- Tray-less dining in the cafeteria
- A glass recycling program (prior to the current recycling at Ricki Recycling).
- Planting trees on campus each spring
- Dozens of ASU students involved with sustainability related events such as the game day recycling challenge (at football games) and Recycle Mania national competitions.
- Installation of a bicycle repair station on campus

E.A.R.T.H. has teamed up with Facilities Services, Community Partnerships, Recycle Creede, Waste Free SLV, Ricki Recycling, Finance Office, Sodexo, and many community organizations with our efforts, and have created the momentum needed to meet the goals set by the American College & University President Climate Commitment (ACUPCC) on which ASU is a signatory.

E.A.R.T.H. initiatives could be a selling point for ASU in student recruitment. The Princeton Review cited in its “College Hopes & Worries Survey”, that environmental issues are a big factor in many students' decision-making process. In answer to the question "If you (your child) had a way to compare colleges based on their commitment to environmental issues how much would this contribute to your/your child’s decision to apply to or attend a school?", 64% of respondents said they would favor having such information and 24% said it would "Strongly" or "Very Much" contribute to their assessment of a school.

E.A.R.T.H. activities also provide students with a sense of community, a means of student involvement in an international environmental awareness movement of climate change, and ways of practicing social responsibility at a critical time in their lives. A student branch of E.A.R.T.H. empowers dedicated students to support green practices.

Dedication to students awarded with the Porter Scholarship

- Over the past ten years, Earth Science faculty have taken over 50 students on educational field excursions to New Mexico, Arizona, East Africa (Tanzania and Kenya), and all over Colorado to study earth sciences. The most recent of these trips was in the past five years when we went to Colorado mammoth sites, Rocky Mountain National Park, and the National Climate Data Center to discuss climate change in the Rockies. Approximately 25 of the 50 students were Porter Scholars.
- Over the past five years, Earth Science faculty have conducted independent field research with 4 Porter Scholars resulting in published abstracts for each of them at national conferences.

Criterion 5 Cost & Benefit of the program

Salaries and program delivery costs

Table 5.1 Cost of the Earth Science Program Note that these calculations are based on AY 2017-18 faculty salaries. *The Administrative Assistant position, SMT Instructional expenses, and SMT Administrative expenses are shared with two departments (4 programs) in Porter Hall. The costs provided here represent ¼ of the total cost.

Cost Type	**Amount**
Faculty Salaries	$124,708
Faculty Benefits	$38,380
Operating Expenses	$5,786
Laboratory Course Fees	$3,782
Administrative Assistant Salary*	$10,857
Administrative Assistant Benefits*	$2,471
SMT Instructional Expenses*	$2,559
SMT Administrative Expenses*	$923.75
Total Cost of Program	$189,466.75

Table 5.2 Cost of the program per metric. All calculations are based on AY 2017-18 faculty salaries; both faculty are full professors. **Calculation based on the average number of graduates in the past three years. ***Calculation based AY 2016-17 SCH.

Metric	**Amount**
cost/FT faculty*	$94,733.38
cost/graduate**	$29,931.26
cost/SCH**	$130.85

The number of graduates in the past two years was low compared to other years in the five-year period. The cost of the program per graduate over the past five years is much less at $23,390.96. This number is based on the average number of graduates/year of 8.1 and the annual cost of the program at $189,466.75.

Revenue generated by the program

The following revenue was generated over the past five years:

- Donation to Geology Gift fund ($1000)
- Scholarship donations for geology students from Colorado geology clubs ($1000)
- Faculty in the earth science program have contributed to the following grants in support of our program:
    - *Increasing Student Engagement and Success in STEM Studies (ISES STEM) at Adams State College*; $3,600,000 over five years
- Grant applications in process:
    - NSF Improving Undergraduate STEM Education: Hispanic-Serving Institutions Program; estimated budget is $1,500,000 over five years
- An off-campus, summer intensive field course is offered annually by the geology faculty and has attracted field geology undergraduates from major universities across North America (*e.g.*, Rutgers, Purdue, St. Norbert's, University of Saskatchewan). The course is in such high demand, the roster is often filled and paid for more than 6 months in advance. At the conclusion of the 2018 course, ASU will have realized $89,648 in unrestricted income in 4 years (Table 5.3). It should be noted that the faculty member is not required to offer this course as it is not part of the academic year load.

Table 5.3 Field Camp revenue. *Revenue is based on 30% overhead assessed by ASU.

Year of offering	Number of ASU student participants	Number of non-ASU student participants	Revenue generated*
2015 [**26** students]	1	25	$21,840 [$2800/student]
2016 [**27** students]	2	25	$22,680 [$2800/student]
2017 [**26** students]	6	19	$21,840 [$2800/student]
2018 (fully enrolled and paid) [**27** students]	5	22	$23,288 [$2875/student]
Total [105 students]	**14**	**91**	**$89,648**

Formal and documented recruiting efforts by program personnel

Faculty in the earth science program have participated in the following recruitment activities:

- Representing ASU at the Colorado Science & Engineering Fair to award scholarships
- SLV Career Fair (2016 and 2017)
- Discover Days

Evidence of recruiting success (students matriculating)

The Earth science program has seen an increase in the number of students transferring into the program from the community college system and 4 year universities. Based on student feedback, some of this is due to the reputation of the ASU Earth Science program within the Community College and 4-year system and recommendations from faculty.

Criterion 6 Faculty & program strengths and accomplishments

Faculty credentials, skills, flexibility, breadth/depth, etc.

Both faculty in the earth science program are full professors with terminal degrees. We have one geologist and one physical geographer, who must teach all courses within the two disciplines. This provides us no flexibility in cases of faculty leaves (sabbatical, parental, medical) and due to location, it is difficult to hire locally to fill temporary vacancies.

Furthermore, the geology professor brings significant private-sector, natural-resource extraction, and environmental assessment experience to augment academic course offerings. This experience spans nearly 40 years of field work and GIS experience. Additionally, the geography professor brings park ranger and naturalist experience with academic training in geology, environmental science and geography. His work is internationally recognized.

All earth science faculty are committed to continued training and both have earned Certificates in College Teaching and Learning (ESCALA Educational Service).

Faculty are also committed to service to the academic discipline and have held a variety of positions (Table 6.1).

Table 6.1. Service to the academic discipline by faculty member for a five-year period (2012-13 to 2016-17) This table includes the organization in each activity category in which an individual faculty member served. Years served are indicated parenthetically.

	1	2
Reviewer	Geological Society of America Graduate Student Awards (5)) Geological Society of America Senior Scholar Awards (5) Journal: Geoarchaeology, an International journal (1) Journal: Great Plains Research (1) Journal: Quaternary International (1)	
Judge at Regional/National Scientific Conferences	Association of American Geographers Regional Conference student poster awards (1)	
Board member	Board of Trustees, University Press of Colorado (2 years) Vice President of the Colorado Field Institute (3 years)	

Facilitator	Association of American Geographers GeoBowl (1)	
Conference/Workshop Host	Western Slope Field Conference (2)	Western Slope Field Conference (2)

Faculty are also committed to scholarly activity by presenting papers, publishing, and applying for grants. Faculty activity is presented in Table 6.2.

Table 6.2. Scholarly activity by faculty member for a five-year period (2012-13 to 2016-17) This table includes the number of presentations, publications, and grants by individual faculty.

	1	2
Presentations	Poster Presentations: Geological Society of America (3) Association of American Geographers (7) Paleoamerican Odyssey (1) Paper Presentations: Geological Society of America (3) Association of American Geographers (1) Tertiary and Quaternary Society of America (1) Colorado Council of Professional Archaeologists (1) Colorado State University Brown Bag Series (1) Fort Collins Rotary Club (1)	Poster presentations: Geological Society of America (3) Lilly Conference (1)
Papers	Peer Reviewed articles by journal: Nature (1) Nature, Brief Communications Arising (1) Current Research in the Pleistocene (1) PaleoAmerica (1) EARTH Magazine (1) San Luis Valley Historian (1) Quaternary Research (1) Peer Reviewed book chapters by book:	Chapter *in* The San Luis Valley: Geology, Ecology, and Human History (in press) *Colorado Encyclopedia* https://coloradoencyclopedia.org/article/colorado-geology. *Geologic Rail Log of the Cumbres and Toltec Scenic Railway*, Colorado Geological Survey, the New Mexico Bureau of Minerals, Minerals and Geology, and Adams State University (in press)

	The Geology of the Ouray-Silverton Area (1) The San Luis Valley: Geology, Ecology, and Human History (1, in press) Books: The San Luis Valley: Geology, Ecology, and Human History (1, in press) Technical published reports by receiving agency: Denver Museum of Nature and Science (1) U.S. Fish and Wildlife (2)	
Grants	Title V Research and Engagement Grant (2); $8,000 *Faculty Development Grant. HILOS Grant*. $2,000 Teaching Improvement Grant. HILOS Grant. $2,000 Student Engagement Grant. HILOS Grant. $1,000 The Denver Museum of Nature and Science. $4,000 *Development of a Multidisciplinary X-Ray Diffraction Course to Increase Retention of STEM Students.* National Science Foundation. Coauthor. $112,000. NOT FUNDED	*Development of a Multidisciplinary X-Ray Diffraction Course to Increase Retention of STEM Students.* National Science Foundation. Coauthor. $112,000. NOT FUNDED

Quality of the curriculum

There is no external accreditation for Earth Sciences programs. This is due to the diversity and varied niches of geosciences programs. In 2012, the American Geological Institute started work to address this challenge, releasing a report in 2014. Three possible solutions were suggested, all with varying levels of flexibility and verification. Pros and cons of traditional accreditation, and two other styles, classification and competency based were suggested. ASU Earth Sciences would best fit under the competency model.

While there is no national organization that addresses alignment of diverse geoscience degrees to national norms, acceptance of program graduates to well-known universities (*e.g.,* Colorado School of Mines, University of Denver) and post graduate employment in the geoscience private sector are very strong evidence that the program is well aligned with professional expectations. In addition, several courses within the earth science programs currently employ best practices for undergraduate education (Table 6.3).

Table 6.3. Courses employing best practices in undergraduate education (Brewer, 2016)

	Independent Research	Case-based learning	Inquiry-based laboratories	Capstone project
ENV 101 Environmental Science		X	X	
GEOG 212 Natural Resource Management	X	X		
GEOG 330 Nature and Properties of Soils	X	X	X	
GEOL 334 Igneous and Metamorphic Petrology		X	X	
GEOL 343 Sedimentology and Stratigraphy	X	X	X	
GEOG 420 Remote Sensing	X	X	X	
GEOL 495 Field Geology			X	X
GEOG 440 Geography Capstone				X
GEOL 321 Geomorphology	X	X	X	
GEOG 421 Glacial Geography		X		
GEOG 411 Mountain Geography		X		

Quality of physical, online, or other resources (equipment, software, facilities, etc.) required to deliver the program

The Earth Science program is housed within Porter Hall, a newer building that was occupied in 1998. At the time of occupation and in the years since, we have been able to update much of our laboratory equipment and seating. The laboratories are well-equipped for work with undergraduates. Some highlights of our facilities include:

- Soils Laboratory: Research-grade teaching and undergraduate research laboratory that is available to students and faculty at ASU.
- GIS and Remote Sensing Laboratory: A computer laboratory housing 8 computers with dual monitors and specialty software for GIS, cartography, remote sensing, and geochemical modeling. Software includes ESRI ArcGIS, ERDAS Imagine, Corel Draw, Geochemist Workbench
- Thin-section Laboratory: student-accessible rock preparation equipment for petrographic analysis
- Edward M. Ryan Geology Museum: 5000 curated world-class mineral and fossil specimens coupled with an interactive touch table and database in a publicly available venue. This venue enables highly effective student research and learning, as well as community and K-12 outreach.
- Petrographic Microscopy Laboratory: 8 high quality polarizing light microscopes are available for student instruction and research

In addition to our physical resources, program faculty were a driving force behind acquiring a campus-wide GIS licensing structure that will expand opportunities for internships and service-

based learning. In addition, the ESRI Teaching and Learning Center was established, allowing delivery of ESRI and commercial GIS short courses.

Our new collaboration with CSU to offer an Agriculture program at ASU is of potentially great benefit to the San Luis Valley and will allow students from small communities to earn an agriculture degree from a small university rather than attending CSU. This degree program includes several earth science courses.

Criterion 7 Future potential of the program

Earth Sciences have become a critically important component of society during the last century and are projected to become even more important in the next century. Water resources, environmental assessment and protections, wise and efficient land use, responsible use of mapping technologies, and natural hazard mitigation are only a few of the many areas of concern that the Earth Sciences address. Our continued effective and potentially expanded preparation of students for careers in these many areas provides a talented and motivated workforce to tackle the many future challenges and solutions, many of which are not even known at this time. Projected job growth is 10% to more than 15% in Earth Sciences fields, with an average annual salary of $81,780.

Advancing technologies like Geographic Information Systems (GIS) and remote-sensing, and emerging technologies such as Unmanned Aerial Systems (UAS) require a solid integrated approach provided by Earth Sciences programs at ASU. Applied GIS and UAS student research projects are included in many parts of the current program curricula. GIS instruction has been part of the Earth Science curriculum for 21 years, with remote sensing and UAS recently added. Field applications classes have attracted students to ASU from major North American universities.

The Earth Science program has several fully developed ideas to increase retention and recruitment at ASU.

1. Improve recruitment and retention at ASU by adding 1-2 faculty lines to the Earth Sciences with expertise in environmental science and GIS.

To continue growing the Earth Science program and to meet the needs of our majors, it is crucial that the number of faculty is increased. The information below shows the number of earth science faculty at our peer institutions.

- Ft. Lewis College:
    - Department of Geosciences: 6 full-time faculty, 3 visiting instructors
    - Environmental Studies: 3 full-time faculty, 1 visiting professor, 1 visiting instructor
- Colorado Mesa University:
    - Geosciences Program: 5 full-time faculty
    - GIS and Technology: 3 full-time faculty
    - Environmental Science: 3 full-time faculty, 8 adjunct faculty
- Western State Colorado University:
    - Geosciences: 4 full-time faculty, 5 lecturers
    - Environment and Sustainability Program: 3 full-time faculty, 13 other faculty from various departments on campus

Each of these institutions have committed to providing a well-rounded education in the earth sciences, environmental science, and sustainability, all of which are popular among today's young people and vital to our nation and the world. Currently, there are numerous jobs available in these fields, and more on the horizon, for well-prepared students. We have many students who come to Adams State that are interested in studying environmental science (66 minors over

the past 5 years; average of 13.2 per year), with many more inquiries regarding our offerings in this area. We would envision strengthening the current environmental science minor with the addition of another faculty member and perhaps developing a major in environmental science.

Geographic Information Systems (GIS) is a rapidly growing field in the Earth Sciences and is heavily utilized by natural resource management agencies and industries. For this reason, students that are well trained in GIS are highly sought-after by these agencies and are more likely to be accepted into graduate programs. We are able to offer introductory courses in GIS and Remote Sensing, but the lack of further training in this important Earth Sciences discipline has a negative effect on the recruitment and retention of students. In addition, development of additional GIS courses would provide opportunities for students in other majors such as Anthropology and Business. More environmental sciences and GIS offerings on campus will help us recruit and retain more students.

An investment in the Earth Sciences is an investment with excellent job prospects

- The Earth Sciences (Geology, Physical Geography, and Environmental Science) offer students well-paying jobs with high job satisfaction. Since 2006, ASU Earth Science graduates have enjoyed the following rates of acceptance/hiring: graduate school 100% (*N* = 6), industry 100% (*N* = 10), natural resources agencies 100% (*N* = 14), secondary education 100% (N = 4), and outdoor education and recreation 100% (N = 3).
- Based on data from the Colorado Department of Higher Education EdPays website (http://co.edpays.org/Report/compare-graduate-earnings-programs-and-institutions?dl=21&i=168&rm=1) Adams State B.S. graduates in the Earth Sciences have more earning power in the 1st and 5th year following graduation than any other ASU discipline with the exception of RNs . In addition, job outlooks for the next 10 years are positive for students with degrees in physical geography, environmental sciences, and geology.
- ASU Earth Science graduates are highly employable and the number of available jobs is increasing.

Increase retention based on ASU's unique location

- A major goal at ASU is to increase retention. In the Earth Sciences, we have a program that regularly has about 40 to 50 majors with a mean graduation rate of 8.2 per year for the past 5 years. That is a significant achievement in retention.
- Earth Science majors may be more likely to stay in Alamosa than the average student. The number of transfer students to ASU Earth Science's programs from more urban community college and universities is indicative of this trend. ASU offers students the unique opportunity to live in a mountain valley with access to textbook examples of geologic processes. Students who are interested in the Earth Sciences are often also interested in hiking, camping, mountain sports, etc., something that we have no shortage of in the area. ASU loses students because Alamosa doesn't have a mall; Earth Science majors laugh at those students. An investment in the Earth Sciences will be an investment in retention at ASU.

In summary, the addition of 1-2 full-time, tenure-track professors who are broadly trained in Earth and Environmental Sciences as well as GIS would have a significant impact on the ability of the program to offer students diversity of thought, current expertise in key subject areas (e.g., GIS), and an option to pursue more extensive studies in environmental science. In addition, we can enhance our offerings in Geography and Geology while increasing ASU's recruitment and retention of students.

2. Build an interdisciplinary major with Adventure Programs

Both Earth Sciences and Adventure Leadership Programs have excellent retention rates. As stated above, this may be largely due to our unique geographic location and outdoor laboratories here in the SLV. We propose to take advantage of this important statistic by collaborating with Adventure Programs to build an interdisciplinary degree.

The proposed major would be housed in the Earth Sciences program and would consist of degrees in the following:

- Earth Sciences: Adventure Recreation Emphasis
- Earth Sciences: Conservation Education Emphasis

The proposed degree plans have been collaboratively developed by Earth Science and Adventure Leadership Program faculty. The degree plans largely utilize existing courses and would not require an additional faculty member.

3. Develop an online presence for lower-level Earth Science courses.

Development of hybrid courses incorporating online lecture and discussion material coupled with field work intensives on campus. Example courses include customized versions of Physical Geology (GEOL 111), Earth History (GEOL 112), Physical Geography (GEOG 101), Environmental Science (ENV 101), and Natural Resource Management (GEOG 212), and other courses with a lab or field component. The target audiences include K-12 teachers, general interest community members, transfer students, and current majors and minors who are out-of-sync with course offerings, or just trying to graduate sooner.

Opportunities for collaboration or partnerships with other institutions

- GIS collaborations with campus infrastructure, local and regional groups are possible, likely imminent.
- The emerging UAS (unmanned aerial systems) technology sector has enormous local potential for collaboration and growth. Initial groundwork has already been completed for this collaboration and is a logical interface for the Earth Sciences.
- Soils and collaboration with CSU extension, NRCS, and local agriculture

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